

AMATEUR SATELLITE REPORT

AMSAT's Newsletter for the Amateur Space Program.



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New AMSAT Video Tape Librarian Tom Larson, N1CHM recording the Space Symposium on video and audio tape.

AO-10 IHU Memory Fault Confirmed

AMSAT engineers have confirmed earlier diagnoses that an AO-10 memory fault has developed. The fault will have no effect on operations or overall spacecraft longevity according to AMSAT officials. According to Jan King, W3GEY, AMSAT's Engineering Vice President, the fault in the Integrated Housekeeping Unit (IHU) memory appears to have been caused by a heavy particle impact; possibly the debris of an energetic cosmic ray.

The IHU memory has been designed to accommodate both soft errors, the kind that are encountered randomly and are one-shot events, and so-called hard errors; ones which represent a physical change in hardware and are permanent. The IHU software can not only detect errors when they occur, but can automatically correct for most errors so as to avoid any serious consequences. The satellite is completely under computer control and any uncorrected software error could be devastating. The system is also designed to count the number of times the error-correcting feature has been used. This count comprises an index to the number of errors incurred. Several weeks ago engineers began to notice an increase in the number of hits ex-

NEWS FLASH

Telemetry format and contents on UO-9 and UO-11 are being changed. New DCE tests are being performed on UO-11. Full orbital data is being carried on UO-9. When UO-11 145 MHz beacon is silent, listen on the 435 MHz frequency. Watch UO-9, UO-11 and this space for further details.

perienced. It was unclear at the time whether they were due to soft errors or one of several types of hard errors.

A diagnostic software routine designed by Karl Meinzer, DJ4ZC, recently confirmed, however, that the errors are hardware-based. The fault has been identified in specific memory locations, hex 0781 and 3D81. King points out that it is quite likely the fault lies in adjacent memory cells; adjacent real estate on the silicon memory die itself. This could be due, King asserted, to either a latent manufacturing defect or the impact of a heavy particle. The area of memory affected is normally allocated to data rather than operating



(l. to r.) Karl Meinzer, DJ4ZC, AMSAT DL President; Jan King, W3GEY, AMSAT Founding Director and VP/E; Harry Yoneda, JA1ANG, JAMSAT President; Vern Riportella, WA2LQQ, AMSAT President; Group assembled at the 1985 AGM in Vail.



Science Education Advisor Richard Ensign addresses the Symposium.

system, says King, so the overall prognosis is excellent.

The memory chips, 16K NMOS devices, were modified by AMSAT to reduce radiation susceptibility. The modification included a tantalum metal applique on the chip and a brass enclosure. Nevertheless, an energetic cosmic ray or the debris resulting from one can pass through many meters of lead according to AMSAT.

Identification of a specific failure site by DJ4ZC eliminates several significantly more worrisome possibilities. Indeed, says King, the error correcting methods chosen were designed to accommodate these anticipated, radiation-induced incidents quite well and the system seems to be working.

"Of the types of hard failures possible," King said, "this type is one of the least troubling."

Solid State Mode L Amplifier

An article by Al Ward, WB5LUA, in the December issue of QST details plans for solid state 1296 MHz amplifiers capable of up to 18 watts output. As Al points out in the article, these units will work well at 1269 MHz too. When used to drive a 2C39 amplifier, they appear just the ticket to get on AO-10 Mode L now. When Phase 3C is launched next year, these amplifiers, when coupled to a 22 or 24 dBi antenna array, will provide access to the improved Mode L on the new bird. The amplifiers described use NEC 1300 series transistors and were shown at the Central States VHF Society meeting earlier this year.

Short Bursts

• The operating schedule of AO-10 will remain unchanged for the present. Battery condition is stable and favorable. Watch the AO-10 beacon for early word on any changes in the operating schedule contemplated. The current operating schedule is:

Mode B	055-119
Mode L	120-136
Mode B	137-203
Off	204-239
Mode B	240-019
Off	020-054

An attitude maneuver was planned for 9-11 December. The transponder was to be turned off during the perigee passage for this maneuver. Target attitude was said to be about 185 degrees longitude and 0 degrees latitude but this was not finalized at press time.

• The first trial run of the Mode L portion of the ZRO-Memorial Technical Achievement Award test will be held on January 1 at 2230 UTC. The downlink will be 436.200 MHz, approximately. This will not be an official test run but just a trial to try out the equipment and procedures.

• The next Mode B ZRO-test run will be January 1 at 2330 UTC. The downlink will be 145.940 MHz.

• The next scheduled Mode B satellite bulletins will be on January 2 at 0100 UTC. The downlink will be 145.962 MHz.



Enjoying a moment of levity at the Symposium, are two of AMSAT's foremost technical experts. Phil Karn, KA9Q, AMSAT Assistant VP/Engineering, and Karl Meinzer, KJ4ZC, AMSAT DL President.

MARCE NEWS FLASH

AMSAT Seeks Reduced AO-10 Traffic During MARCE Relay Try

AMSAT managers are appealing to AMSAT OSCAR 10 users to reduce or eliminate use of the Mode B transponder during a special event later this month. For a few hours between 18 and 21 December, the Getaway Special canister MARCE will attempt to relay telemetry through AO-10 Mode B.

This is a splendid opportunity to set a new kind of precedent; one that was thought highly improbable until recently, according to AMSAT officials. It would go a long way to establishing future mission capabilities as well, ASR has been told. But since the MARCE 70 cm emissions are QRP, the load on AO-10 Mode B transponder will have to be very light in order for the QRP MARCE uplink to be heard on the AO-10, Mode B downlink. The MARCE telemetry package is using only 6 watts ERP.

The times to avoid AO-10 use are:

First Session:

18 Dec 23:40 through 19 Dec 07:30 UTC

Second Session:

19 Dec 20:10 through 20 Dec 02:45 UTC

Third Session:

20 Dec 19:00 through 21 Dec 01:00 UTC

Although MARCE will be transmitting beyond these times, due to spacecraft position and mutual visibility, these are the only times that relay through AO-10 will be possible.

AMSAT is offering two awards for MARCE telemetry capture. A Letter of Recognition will be sent to all who submit a bona fide audio cassette of the direct MARCE downlink on 435.033 MHz FM.

Moreover, a Special Technical Achievement Award certificate will be presented to anyone who submits a bona fide audio cassette of the MARCE telemetry RELAYED through AO-10. The downlink on AO-10 will be 145.972 MHz $\pm$ 13 kHz using FM.

Submit cassettes to N6ARE, 475 North Diasy Avenue, Pasadena, CA 91107. No cassettes will be returned unless return postage in full is enclosed.

Cassettes will be analyzed by AMSAT for authenticity and then forwarded to MARCE program officials for analysis.

AMSAT hopes to have most AO-10 users listening for the relayed MARCE downlink (rather than transmitting) on AO-10 during the three sessions so the load on the transponder will be very low and, if fact, facilitate this unique opportunity for all to participate in an historic event!

MARCE To Fly With Shuttle; Awards For Telemetry Offered

The launch of the Marshall Amateur Radio Club Experiment (MARCE) aboard STS-61C has been scheduled for 1200 UTC on December 18 according to MARCE Project Coordinator Ed Stluka, W4QAU.

Synthesized voice telemetry will report the conditions within the MARCE Get Away Special canister during the progress of several experiments. The direct downlink frequency will be 435.033 MHz using FM. An AMSAT Letter of Recognition will be presented to all who submit a bona fide audio cassette recording of the MARCE telemetry received by direct reception from the Shuttle.

Telemetry relay through AO-10 may be possible under very special conditions. The relayed downlink will likely be on Special Service Channel H1, 145.972 plus or minus 12.7 kHz Doppler shift according to NASA's Gil Carman, WA5NOM, of the Johnson Space Center who did much of the orbit analysis and plotting for MARCE.

Realization of telemetry relay from a Get Away Special canister to another Amateur satellite would be seen as a major achievement in the history of Amateur Satellites. AMSAT will be issuing a Special Technical Achievement Award certificate to anyone who submits a bona fide audio cassette recording of MARCE telemetry as relayed through AO-10.

Although the direct downlinks will be strong enough (6 watts ERP) to be heard well with even modest equipment, the timing of the emissions limits direct access to the Southern Hemisphere but including Japan. MARCE is powered by an internal 50 ampere hour silver zinc battery and



Ed Stluka, W4QAU — MARCE antenna installation process. Antenna must be disassembled for connection and installation on the gas canister lid.



Paul Shuch, N6TX, phrases a question for AMSAT officials at the Symposium.

the transmissions are limited to conserve battery life. A half-wave dipole is mounted atop the canister and is fully exposed. The Shuttle Columbia will have its payload bay facing the earth for much of the mission so a strong signal can be expected.

However, what's good for direct reception is poor for relay through AO-10 since AO-10, with apogee at 35,300 km and perigee at 4100 km is always higher than the 336 km



Executive Vice President John Champa, K8OCL, tells the 1985 Space Symposium of ARTOB plans.

altitude of Columbia. With the payload bay facing earth most of the time, "Satellite access will be most likely for approximately 6 minutes just before and after each earth eclipse when AO-10 is within about 18 degrees of the earth horizon" as seen from Columbia, says WA5NOM.

Four major experiments are in the GAS can. Besides the Amateur Radio portion, there is an alloy solidification experiment, a plant physiology experiment and a crystal growth experiment. A series of measurements are telemetered by radio in three separate sequences as described in the tables below.

MARCE managers and AMSAT are soliciting telemetry capture assistance from Southern Hemisphere stations especially. Contact N6ARE ASAP at 475 North Daisy Avenue, Pasadena, CA 91107. Or call 818-449-7088 to offer your assistance and to receive an informative data packet.

All submissions of cassettes for awards should be forwarded to N6ARE at the same address. Cassettes will not be returned unless return postage in full is provided.

Special MARCE Support Data

The preliminary Keplerian elements for 61C are as follows:

Set:	NASA Element Set #3
Epoch:	85 352.99372106
Drag:	2.5e-04
Inclination:	28.6741
RAAN:	95.3371
Eccentricity:	0.0008376
Arg Perigee:	97.4619
Mean Anomaly:	70.2603
Mean Motion:	15.78856556
Ref Ep Orbit:	9

If the actual launch is later than planned, add the difference to the epoch and increase the RAAN by 15.04107 degrees per hour and resolve to 360 degrees.

Detailed Direct Downlink Schedule

First Downlink Session: Orbits 8-14

Tx on 30 sec/min

Orbit #	UTC DD/HH:MM:SS
8	18/22:18:01
9	19/23:49:02
10	19/01:20:03
11	19/02:51:03
12	19/04:22:04
13	19/05:53:05
14	19/07:24:05

Second Downlink Session: Orbits 22-27

Tx on 45 sec/min

Orbit #	UTC
22	19/19:32:11
23	19/21:03:11
24	19/22:34:12
25	20/00:05:12
26	20/01:36:13
27	20/03:07:14

Third Downlink Session: Orbits 37-42

Tx on 45 sec/min

Orbit #	UTC
37	20/18:17:19
38	20/19:48:20
39	20/21:19:21
40	20/22:50:21
41	21/00:21:22
42	21/01:52:22

Telemetry Decoding

Telemetry will be sent in either of two formats:

Sample Data in format A:

QST QST QST FROM WA4NZD TIME 00000
STATUS 10 DATA 012 014 014 014 015 012 225
135 255 FROM WA4NZD OUT

Sample data in format B:

(Employed when alloy solidification experiment is on).

QST QST QST FROM WA4NZD TIME 00000
STATUS 10 DATA 012 014 014 014 015 012 225
135 255
STATUS 98 TIME 0000 DATA 3F 4A 3B 3C 3D
42 AF A2 FROM WA4NZD OUT

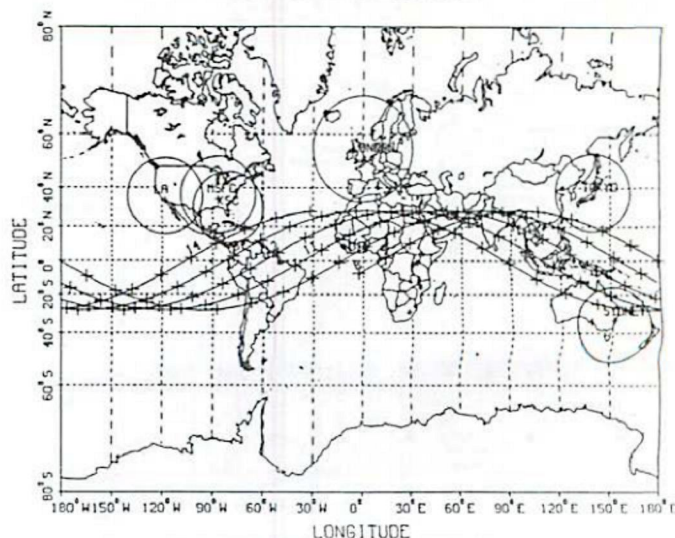
Format A and B status codes explanation.

Status word is a two digit hex number ranging from 01 to ff. The status word encodes the condition of any combination of 8 variables. Taking the arithmetic sum of the status point codes yields the transmitted code word.

Condition	Status Point	Voice Hex Value
A/D Converter failure	0	01
Canister pressure too low	1	02
Transmitter on too long	2	04
GCD "B" Transmitter relay off	3	08
GCD "C" Control relay off	4	10
Exp #1 Over-temperature	5	20
Exp #2 or #3 are on	6	40
Battery voltage is too low	7	80

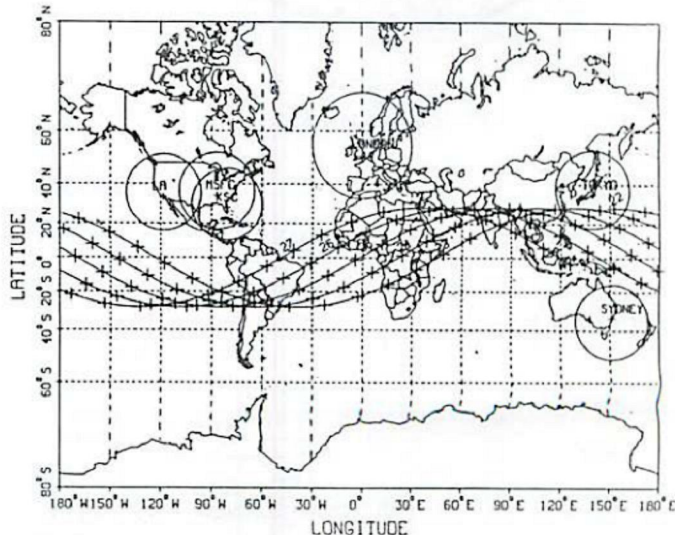
STS 61-C GROUNDTRACKS

GAS 007 FIRST DOWNLINK



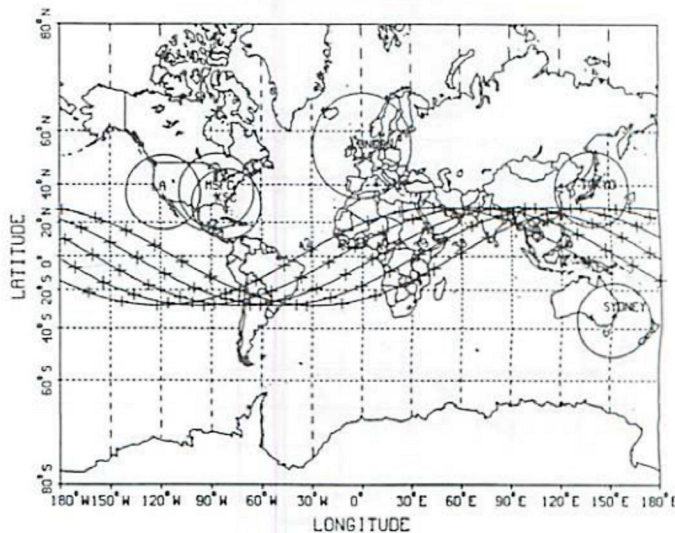
STS 61-C GROUNDTRACKS

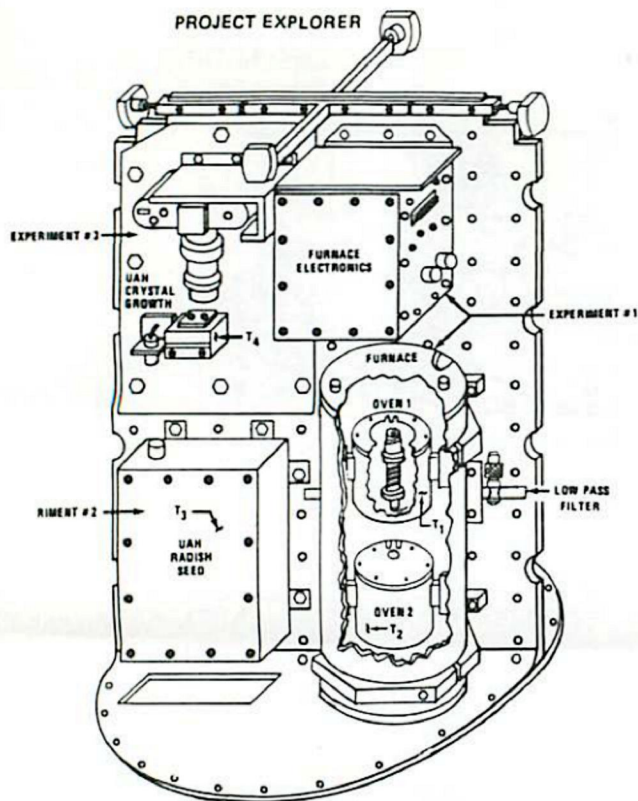
GAS 007 SECOND DOWNLINK



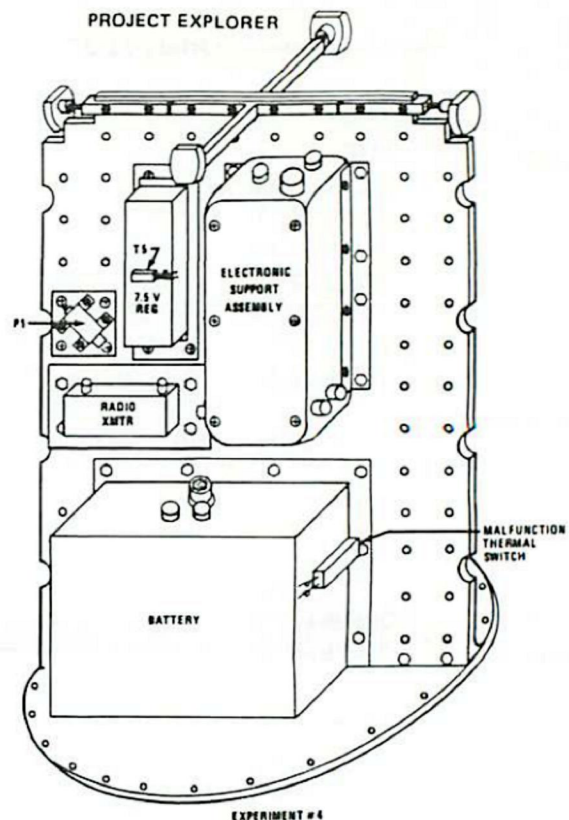
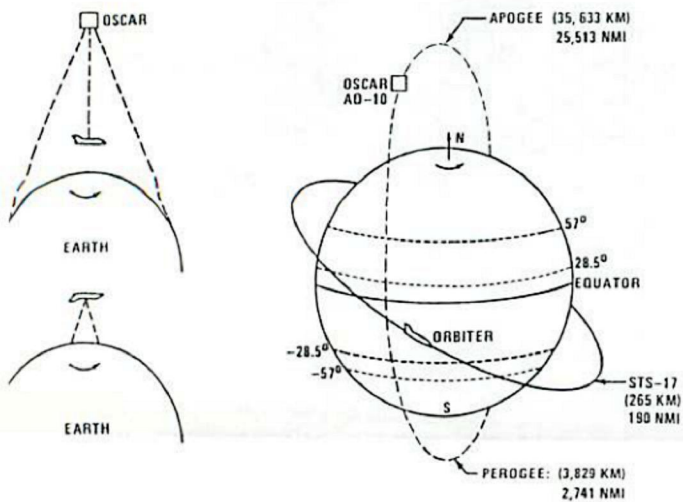
STS 61-C GROUNDTRACKS

GAS 007 THIRD DOWNLINK

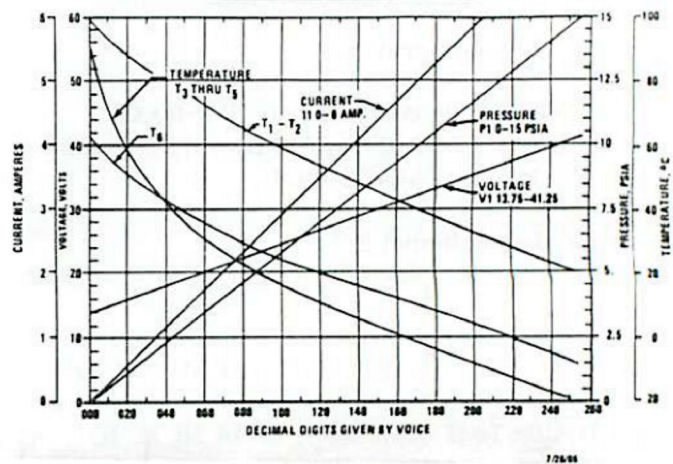




CONSIDERATIONS FOR MARCE COMMUNICATIONS



GAS 007 MARCE DATA SYSTEM TELEMTRY

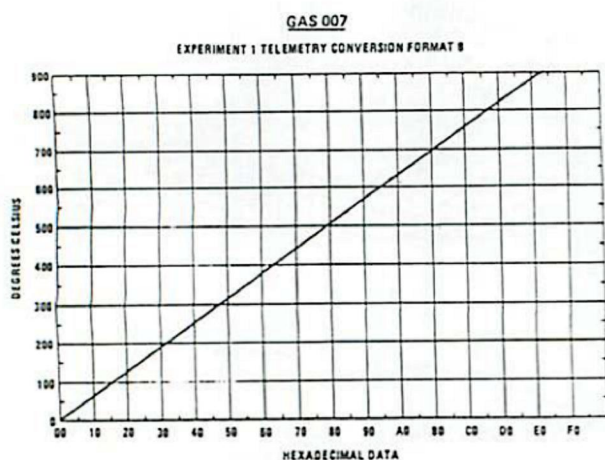


Example: Status word A1 is sent.

A/D error	0	01
Exp #1 Over Temp 5	20	
Battery V low	7	80
hex sum		A1

Format B status code explanation:

Condition	Voice Hex Value
Power on	98
Heat up	1E
Regulate	B6
Experiment	D9
Cool down	CD
Shut off	C8



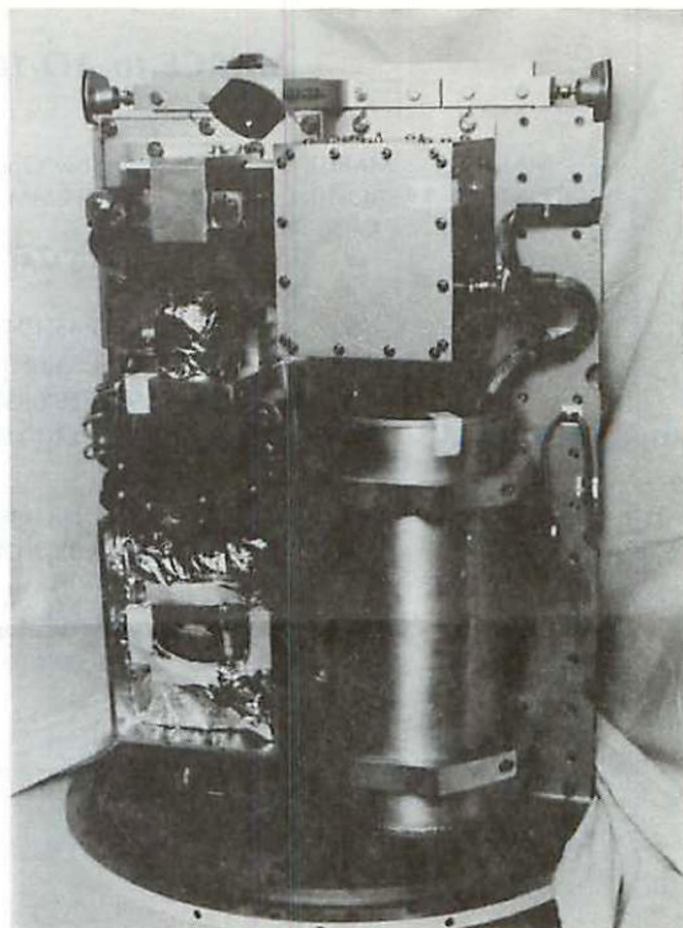
Data value explanation:

Data values are obtained from the accompanying graphs. The data values encode the levels of certain measurements as follows:

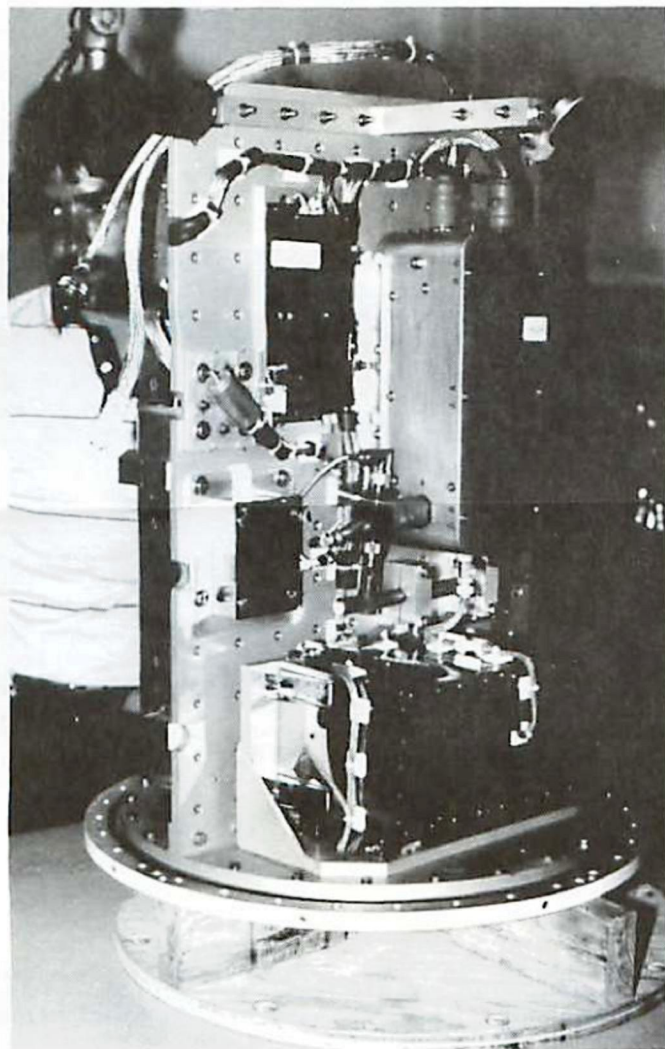
Data Item #	Parameter Encoded	Designation	Remarks
1	Oven #1 temperature	T1	Alloy solidification
2	Oven #2 temperature	T2	Alloy solidification
3	Experiment #3 temperature	T3	Plant physiology
4	Experiment #4 temperature	T4	Crystal growth
5	Container temperature	T5	
6	Battery temperature	T6	
7	Battery voltage	V1	
8	Battery current	I1	
9	Container pressure	P1	

Command code explanation:

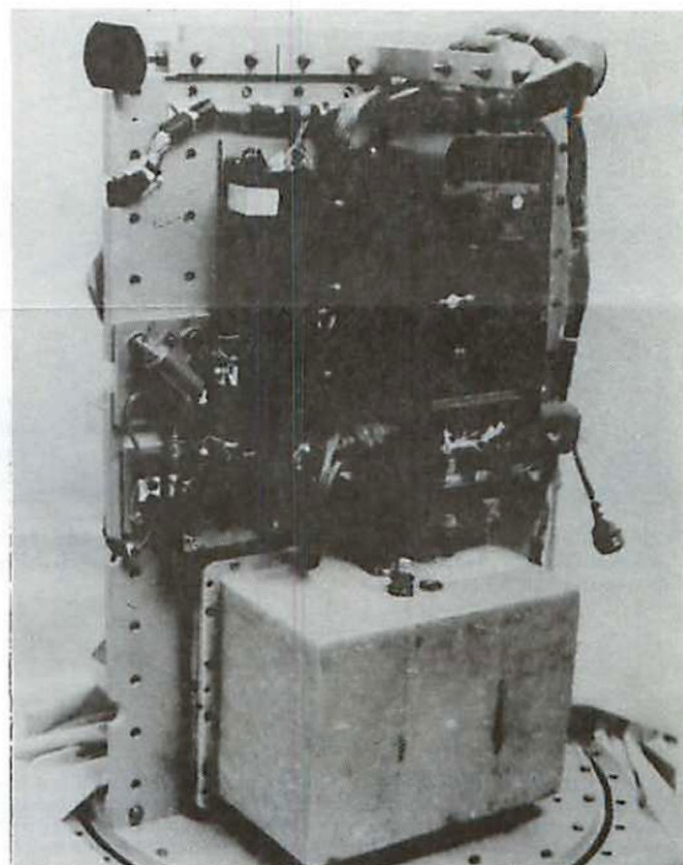
GCD "A" PPC "D": Turns GAS on/off
 GCD "B" Radio tx power
 GCD "C" Turns on experiments 1, 2, 3 and 4.



Experiments #1, 2 & 3. Exp. #2 cover is removed. MARCE low pass filter is under Exp. #1 oven.



Exp. #4 MARCE ready for gas #007 installation into the gas canister and for flight.

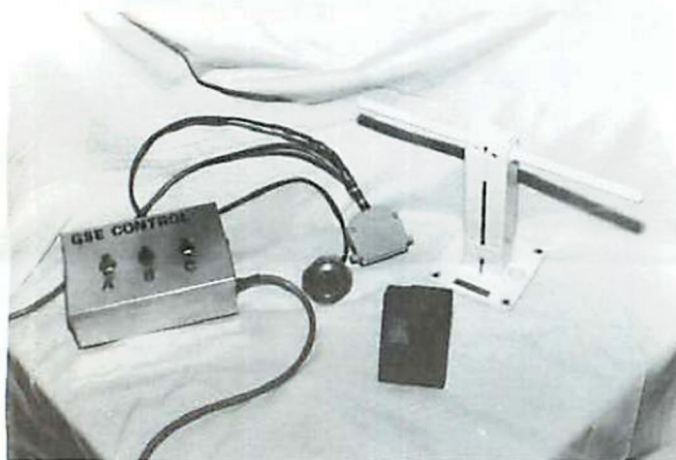


Experiment #4, MARCE, with new SRB battery. Electronic support assembly cover is removed.

MARCE to AO-10 Relay Opportunities

MARCE Downlink Session Number	MARCE AO-10 Relay #	61C Orbit #	Window Opens DD/HH:MM (UTC) [AO-10 MA]	Window Closes DD/HH:MM (UTC) [AO-10 MA]	Total Relay Time (Minutes)	Remarks
1	1	8	18/23:45[194]	18/23:57[198]	12	First xmsn
1	2	12	19/04:53[050]	19/05:45[069]	52	
1	3	13	19/06:29[085]	19/07:21[104]	52	
2	4	22	19/20:14[131]	19/21:07[151]	37	Mode B on at MA 137; 20:30 UTC
2	5	23	19/21:50[166]	19/22:42[185]	52	
2	6	24	19/23:27[202]	20/00:20[221]	3	Mode B off at MA 203; 23:30 UTC
2	7	25	20/01:19[243]	20/02:41[17]	82	AO-10 perigee
3	8	37	20/19:00[119]	20/19:52[138]	3	Mode B on at MA 137; 19:49 UTC
3	9	38	20/20:35[154]	20/21:27[173]	52	
3	10	39	20/22:11[189]	20/23:03[208]	38	Mode B off at MA 203; 22:49 UTC
3	11	40	20/23:53[226]	21/00:51[247]	19	Mode B on at MA 240; 00:32 UTC

Total possible relay time: 402 Minutes; 6.7 hours



GSE Test Set: Control box, Motorola receiver (435.033 MHz) and flight antenna. Gas #007, Project Explorer. STS-61C flight configuration, ready for the Dec. 20, 1985 flight.



Martha Saragovitz, Director of Administration, accepts the 1985 Member Service Award from President WA2LQQ.

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